Price and Wage Rigidities in the Republic of Macedonia: Survey Evidence from Micro-Level Data

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This paper exploits the information collected from an ad hoc survey conducted on a sample of Macedonian firms to study the extent of nominal price and wage rigidities in the Republic of Macedonia. The research was motivated by the observation that sticky prices influence the responsiveness of inflation to changes in a central bank's policy rate.

Against this background, the paper investigates the relative importance of most determinants of the frequency of price and wage changes identified in the literature. This paper presents a Bayesian analysis of ordinal data. Posterior inference is carried out using Markov Chain Monte Carlo (MCMC) techniques. Infusing the model with prior information allows us to shrink the parameter space, resulting in more precise and reliable parameter estimates. Our results suggest that higher price flexibility is associated with a higher degree of product market competition. Specifically, we find that firms facing high levels of domestic and international competition tend to adjust prices faster.

JEL Classification: D21, E30, J31
Keywords: price rigidity, wage rigidity, Bayesian inference, MCMC, survey data

The question of how the price- and wage-setting behavior of firms influences the effects of monetary policy on the economy has taken center stage in the recent literature. Short-run effects of monetary policy on real macroeconomic aggregates are mainly due to the presence of short-term price rigidities, which, through the real interest rate, allow monetary policy to influence real economic activity. Such nominal rigidities play an important role in modern New Keynesian macroeconomic models, which aim to provide key insights on the transmission mechanism of monetary policy to academics and practitioners in central banks and to policy institutions. An understanding of the transmission mechanism is crucial for the correct practical implementation of monetary policy.

Several theoretical studies have outlined the importance of price and wage rigidities on the transmission mechanism of monetary policy (Christoffel et al., 2006) or optimal monetary policy in the presence of wage rigidities (Blanchard and Galí, 2007). Both contributions employ a New Keynesian model with nominal rigidities combined with the Diamond-Mortensen-Pissarides paradigm, thus providing practical guidance on the implementation of optimal monetary policy. This paradigm aims to provide theoretically consistent explanations for phenomena typically occurring in economic systems and their corresponding equilibria. While both studies emphasize the great importance of real rigidity for the actual implementation of monetary policy, the theoretical findings remain inconclusive in explaining how shocks in the labor markets influence monetary policy.

Most theoretical studies provide a rather generic picture, as they investigate aggregate quantities and the reaction of a representative firm to changes of the underlying macroeconomic fundamentals. To provide a deeper understanding of how companies react to shifts in the underlying fundamentals, empirical studies

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have largely been confined to analyzing individual companies by using large cross-sectional panels. Carlton (1986) and Hall et al. (2000) investigate the pricing behavior of firms facing different degrees of competition. They conclude that firms facing more competition tend to adjust prices faster than companies encountering less competition. Carlton (1986) additionally incorporates the time dimension into the model, extending the analysis by explicitly accounting for persistence effects of demand shocks at some point in time on the price dynamics of a commodity. More precisely, a demand shock today influences not only current prices but also the future path of prices. Geroski (1992) and Álvarez and Hernando (2007) investigate the pricing behavior of firms in different sectors in the U.K. and the euro area, respectively. They corroborate the findings of Carlton (1986) and Hall et al. (2000) and establish that firms operating in less competitive sectors tend to exhibit a somewhat slower reaction to shocks.

This paper investigates the relative influence of several important determinants on the frequency of price changes identified in the literature, such as the degree of product market competition, the cost structure or firms' size. Additionally, we employ a model that is able to track idiosyncratic characteristics and that explains why base wages in some companies tend to be more flexible than in others. These characteristics include the institutional setup for wage bargaining, the composition and characteristics of the workforce, and the wage structure. Using a micro-level survey allows us to unveil the relevance of firm characteristics in the determination of price and wage rigidities, thus enabling us to exploit information that usually cannot be observed in administrative sources. Based on the survey data collected, this paper sheds light on what makes it more or less likely that prices and wages will be sticky, i.e. will not respond immediately to changes in market conditions.

We employ a Bayesian ordered probit model that allows us to incorporate information originating from other studies flexibly and efficiently. Exploiting information from other countries improves the quality of our estimates. Moreover, our Bayesian approach allows us to overcome several problems associated with large numbers of "I don't know" responses and insufficient degrees of freedom. Posterior inference is carried out using the Markov Chain Monte Carlo (MCMC) algorithm put forward by Albert and Chib (1993). In addition, we use a hierarchical prior setup that allows us to set the tightness of the prior in a data-based fashion. This allows us to derive posterior quantities which are infused with prior information when the data become increasingly noninformative.

Our results show that the higher price flexibility is directly related to higher degrees of competitive pressure and exposure to foreign sales as well as to a lower labor cost share. In that respect, our results are consistent e.g. with those of Álvarez and Hernando (2007), who analyze the relationship between price flexibility and competition in nine euro area countries. Our findings are also in line with those of Fabiani et al. (2007) and Vermeulen et al. (2012), who report an inverse relationship between the share of labor cost in total costs and the frequency of price adjustments in nine and six countries of the euro area, respectively. This corroborates the findings in Druant et al. (2009), whose work uses survey data collected in 17 European countries. In addition, the presence of higher workforce turnover, the availability of alternative forms of labor cost adjustment (i.e. of bonuses) along with the presence of any type of wage indexation practice translates into higher wage flexibility. Workforce turnover and the flexible wage component

(i.e. the share of bonuses on the firm's total wage bill) are basically margins of adjustment at firms' disposal, in addition to changing base wages, but they could in turn affect wage change mechanisms. Our results are also in line with those of Lebow et al. (2003), Dwyer (2003) and Oyer (2005), who analyze the role of benefits in reducing nominal wage rigidity on the basis of microdata underlying the U.S. Bureau of Labor Statistics' employment cost index (Lebow), Australian microdata (Dwyer), and U.S. data from the National Longitudinal Survey of Youth (Oyer). Their results corroborate those of Druant et al. (2009).

This paper is structured as follows. Section 1 describes the dataset used and provides detailed information on the design of the questionnaire, in parallel presenting some stylized facts emerging from the Macedonian survey evidence in a comparative perspective. Section 2 provides information on the basic econometric framework, prior specifications and the MCMC algorithms employed. Section 3 emphasizes the economic rationale behind the selection of covariates. Section 4 presents the estimation results, and section 5 concludes.

1 Stylized Facts from the Macedonian Survey Evidence Presented in a Comparative Context

The data employed in this paper were collected in a survey which was conducted during the spring of 2014 and which covered a sample of 514 Macedonian firms in manufacturing, construction, trade and other market services. The firms in the final sample account for around 11% of total employment in the Republic of Macedonia. The sample selected is unbiased and representative.[2] The replies seem to be internally consistent. Furthermore, the relatively high response rate (around 80%) promotes confidence in the results. The sample selection is explained in great detail in Ramadani and Naumovski (2014).

The survey applied the harmonized questionnaire of the Wage Dynamics Network (WDN) research project sponsored by a consortium of 23 central banks in the European Union under the lead of the European Central Bank (ECB).[3] This survey was originally carried out by 17 national central banks for countries for which fully harmonized data are available, i.e. Austria, Belgium, the Czech Republic, Estonia, France, Greece, Hungary, Italy, Ireland, Lithuania, Luxembourg, the Netherlands, Poland, Portugal, Slovenia, Slovakia and Spain, between the end of 2007 and mid-2008. The total sample size of the dataset is over 17,000 firms. We use the WDN findings to establish a comparative context for the Macedonian survey evidence discussed below. The WDN has two main research objectives: First, to identify the determinants and features of wage dynamics and labor costs that are pertinent to monetary policy; second, to shed light on the link between wages, labor costs and prices. Furthermore, a series of analytical studies is emerging

[2] *Individual weights were calculated for each firm to make the sample representative of the population of firms and to account for the amount of workers that the firm represents in the population. To this end, three different types of weights were introduced in the dataset: A basic sampling weight to adjust for the unequal probability of firms ending up in the realized sample; an employment-adjusted sampling weight to ensure that the sample represents employees in the population, and a so-called "importance weight" giving each firm in the sample a weight proportional to its size (in terms of employment).*

[3] *For more details on the WDN survey evidence, please refer to the following link: http://www.ecb.europa.eu/home/html/researcher_wdn.en.html. In addition, the October 2012 issue of Labour Economics 19(5) edited by Etienne Wasmer contains a special section on: Price, Wage and Employment Adjustments in 2007–2008 and Some Inferences for the Current European Crisis.*

from this network,[4] thus promoting the circulation of research results and providing a platform for discussion. Among the published research associated with this pooled dataset, we cite Druant et al. (2009), who focus on how European firms' wages and prices are linked, as they provide an infrastructure for our study.

The Macedonian survey questions use 2013 as the reference year. Thus, we find it appropriate to briefly sketch out the prevailing macroeconomic conditions in that period. Economic conditions were broadly favorable in the Republic of Macedonia in 2013. More precisely, following a contraction by 0.4% in 2012, growth accelerated to 2.9% in 2013 and labor markets improved significantly. The recovery was largely driven by the observed broadening of the growth base toward domestic private demand and a better performance of net exports. However, the inflation rate of 2.8% in 2013 to a large extent signaled the transmission of food and import price shocks. In 2013, the financial sector remained resilient. Against this background, monetary conditions were accommodative, with the main policy rate being reduced by 75 basis points to 3.25% in several steps from mid-2012. As a result, credit growth gathered steam from the second half of 2013. However, dynamic household lending growth contrasted with the still weak growth of lending to the corporate sector.

The time gap between the European and the Macedonian surveys spanned the post-2008 global financial and economic crisis period, so that comparisons reflect not only national differences but also changes in the global economic environment. However, note that while favorable economic conditions prevailed in the euro area in the precrisis period, the Republic of Macedonia entered a high-growth period when the survey data were collected.

Several important features of price- and wage-setting behavior have emerged. Below, we focus on some points, in a comparative context, that seem worth emphasizing.

First, the ECB's Final Report of the Wage Dynamics Network[5] (ECB, 2009) shows that prices are adjusted more frequently than wages. This result directly carries over to the Republic of Macedonia: Macedonian survey evidence shows that 30% of the firms revise prices more often than once a year. For the entire euro area, this fraction is 22%, about ten percentage points lower than the non-euro area figure. Moreover, firms that operate in both market services and manufacturing in Macedonia adapt prices much less frequently than those operating in the trade and construction sectors. In parallel, market services have the highest portion of firms reporting that they lack a regular price revision pattern. In addition, in the case of the Republic of Macedonia, survey results show that only 15% of the firms change base wages more often than yearly, which is generally in line with the European aggregate. In this context, around 40% of the European firms confirmed the existence of some correlation between the timing of price and wage changes. Conversely, in the case of the Republic of Macedonia, the majority of firms (70%) did not acknowledge a direct link between the two.

[4] *More information on the pool of research studies arising from this network is available under "Publications" under the following link: http://www.ecb.europa.eu/home/html/researcher_wdn.en.html.*

[5] *The analysis summarized in this report is based on employment-weighted answers. The same type of adjustment is conducted on the Macedonian survey data as well.*

An additional finding stemming from the WDN survey is that wage-setting institutions distinctly determine the nature of both wage dynamics and wage structure. Wage setting displays significant heterogeneity across Europe: Austria, Denmark, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal and Sweden have a broadly regulated system of wage bargaining, which rests on a high number of collective agreements. Conversely, the Czech Republic, Estonia, Hungary, Lithuania, Poland and the U.K. have a largely deregulated system of wage bargaining.

The Republic of Macedonia also uses a broadly deregulated wage negotiation mechanism characterized by relatively loose employment protection. In addition, institutional rigidities are not very strong, social assistance is unlikely to push reservation wages, the tax wedge is modest, and the overall business environment appears to be rather supportive of strong job creation (IMF, 2013). The Macedonian authorities made sizeable efforts to improve the local business environment. Improved indicators raised the Republic of Macedonia's rank to 23rd among the 185 countries in the World Bank's "Ease of Doing Business" index for 2013. To achieve this position, the Republic of Macedonia reduced red tape in a significant number of areas, in turn enhancing working conditions in the private sector most clearly and consequently exerting a positive influence on labor.

The scope to which wages are indexed to inflation in Europe has attracted considerable attention on the part of policymakers. The survey results show that on average, one-third of European firms run a policy that adapts base wages to inflation. Around 29% of the Macedonian firms have a wage indexation mechanism that is predominantly informal and backward looking.

2 Econometric Framework

This section provides a brief overview of the modeling framework employed in the empirical application. More specifically, the following subsections describe the general ordered probit model, the prior setup employed and the corresponding posterior distributions.

2.1 The Ordered Probit Model

Following Albert and Chib (1993), we define the vector of ordered responses $Y=Y_1,...,Y_N$, where Y_i takes one of J ordered categories. Moreover, $X=X_1,...,X_K$ denotes a $N \times K$ matrix of exogenous variables. Finally, we define a latent variable, Y^*, which is related to Y through the definition of a suitable linking function $F(g)$. Regressing y_i^* on X_i yields the following latent variable model

$$y_i^* = X_i\beta + \varepsilon_i,\ \varepsilon_i \sim N(0,1) \tag{1}$$

where y_i^* denotes the i^{th} column of Y^* and β is a K-dimensional coefficient vector. X_i is the i^{th} column of X. Conditional on y_i^*, equation (1) is a simple regression model that can be analyzed using standard methods. To describe the behavior of y_i^*, we introduce a J– dimensional vector $\gamma=(\gamma_0,...,y_J)$ such that

$$y_i = j \ \text{ if } \ \gamma_{j-1} < y_i^* \leq \gamma_j \tag{2}$$

where $\gamma_{j-1} < \cdots \leq \gamma_J$ is necessary (but not sufficient) to identify the model.

As mentioned above, the latent variable y_i^* is related to y_i through $F(g)$. Let us denote the probability that $y_i=j$ as $P(y_j = j)$. Under the assumption that $F(g)= \phi(g)$ equals the cumulative distribution function of the standard normal distribution, the probability of observing $y_i=j$ is given by

$$P(y_i = j \mid \beta, \gamma) = \phi\left(\gamma_j - X_i\beta\right) - \phi\left(\gamma_{j-1} - X_i\beta\right) \quad (3).$$

The model described by equations (1) and (3) is not identified. Thus we have to assume that $\gamma_0 = -\infty$ and $\gamma_J = \infty$.

Again, conditional upon knowledge of γ (and thus Y^*), equation (1) reduces to a simple regression model that can be analyzed using standard prior specifications.

2.2 Prior Distributions

Bayesian analysis requires the researcher to specify prior distributions for each coefficient of the model described above. Under the (necessary) assumption that ε_i is standard normally distributed, we have to choose suitable priors for the elements of β and γ. To control the tightness of the prior on β, we introduce a latent hyper-parameter $\delta \in \mathbb{R}$.

More formally, we impose normal priors on both coefficient vectors, given by:

$$\delta \sim G(a_1, a_2)$$
$$\beta \mid \delta \sim N(\underline{\beta}, \delta\, \underline{V}_\beta)$$
$$\gamma \propto c$$

The hyperparameter δ is treated as a random quantity; thus it is necessary to impose a prior on δ. We specify a gamma prior with parameters a_1 and a_2. This choice has several convenient properties because it imposes the restriction that $\delta \in \mathbb{R}^+$.

The prior on β is a normal prior, where $\underline{\beta}$ denotes a $K\times 1$ vector of prior means and $\underline{V}_\beta$ denotes a $K\times K$ prior variance-covariance. Given that the variance of ε_i equals one, this prior is conjugate, which facilitates well-known conditional posterior solutions (see Koop, 2003).

Finally, the prior on γ is noninformative and improper for each γ_j. This choice reflects the belief that we have no information on the threshold levels of the latent variable y_i^*. Imposing a diffuse prior on γ, motivated in Albert and Chib (1993), has become a standard choice in the literature on the Bayesian estimation of ordered probit models. Another option would be to impose a normal prior that fulfills $\gamma_{j-1} \leq \cdots \leq \gamma_J$. However, unless we have strong information on the specific elements of γ, a flat prior proves to be a convenient choice.

2.3 Posterior Distributions and the Markov Chain Monte Carlo Algorithm

Combining likelihood and prior information yields posterior quantities. Under the prior assumptions described above, the conditional posteriors for β,γ and δ take the following form:

$$\delta \mid \beta, \gamma, Y^*, Y \sim p(\delta \mid Y)$$

$$\beta \mid \gamma, \delta, Y^*, Y \sim N(\overline{\beta}, \overline{V}_\beta)$$

$$\gamma \mid \beta, \gamma, Y^*, Y \sim U(\overline{\gamma}_{j-1}, \overline{\gamma}_{j+1})$$

Unfortunately, the conditional posterior of δ is of not a well-known form. This fact prevents the use of a simple Gibbs sampling scheme for that parameter. Fortunately, however, the marginal likelihood of the (latent) model in (1) is available in closed form under the conjugate prior. This makes it easy to set up a simple Metropolis-Hastings step to simulate δ.

The conditional posterior of β takes a simple form. More specifically, the posterior mean and variance of β are given by:

$$\bar{V}_\beta = \left((\delta \underline{V}_\beta)^{-1} + X'X\right)^{-1}$$
$$\bar{\beta} = \bar{V}_\beta \left((\delta \underline{V}_\beta)^{-1} \underline{\beta} + X'y\right)$$

The latent variable y_i^* can be sampled from the following conditional posterior (see Koop, 2003):

$$y_i^* \mid y_i = j\ ,\ \beta, \gamma \sim N\left(X_i\beta, 1\right) I(\gamma_{J-1} < y_i^* \leq \gamma_J)$$

where $I(\cdot)$ denotes the heavy side function that equals one if its argument is true. Thus the posterior of y_i^* is a truncated normal density from which it is straightforward to sample in general.

Finally, sampling γ can be done quite easily by noting that γ_i has to be between γ_{i-1} and γ_{i+1}. Furthermore, we condition on Y and Y^*, which implies that we know what value of Y^* corresponds to a given value of Y. This leads to a conditional posterior quantity that is uniformly distributed between $\bar{\gamma}_{j-1}$ and $\bar{\gamma}_{j+1}$ (Albert and Chib, 1993).

The conditional posterior distributions described above imply that we can set up a simple Metropolis-within-Gibbs algorithm to simulate the joint posterior of the parameters. Specifically, this implies sequentially drawing the parameters from their conditional distributions with the exception of δ, which is sampled through a simple Metropolis step.

3 Data Overview and Prior Implementation

The following section aims at providing a rough overview of the dataset employed and the specifics of the actual prior implementation.

3.1 Data Structure and the Economic Rationale behind the Selection of Covariates

The questionnaire allows us to extend our knowledge of the effects of different labor market institutions and policies on price- and wage-setting schemes. In addition to information on price and wage setting and adjustments, the survey collects data on firms' features, such as the sector of activity, size, structure of the product market, intensity of competitive pressures in the respective market, structure of the labor force and institutional characteristics potentially affecting wage and labor policies.

The dependent variables employed in this paper were constructed as follows. To model price rigidity, a categorical variable was created by breaking down firms' answers to the question on the frequency of price changes. More precisely, the firms were explicitly asked how often they changed the price of their main product. They were able to select one of the following answers: "daily," "weekly," "monthly,"

"quarterly," "twice a year," "once a year," "every two years," "less than once every two years," "never," or "no predefined pattern." To reduce the complexity, we regrouped the answers into four categories (1 – "daily to monthly," 2 – "quarterly to half-yearly," 3 – "yearly," and 4 – "less frequently than yearly"). Firms that opted for "never" or "no pattern" were not considered in the regression. To model wage rigidity, the value categories of the dependent variable were linked to the degree of stickiness according to one of three categories, with 1 = the firm changes wages more frequently than yearly; 2 = changes wages yearly, and 3 = changes wages less frequently than yearly.

The specific choice of the covariates follows insights provided in Druant et al. (2009), Martins (2013) and Garibaldi (2006). The following section aims to provide a short overview of the explanatory variables included and their economic rationale. The annex provides additional technical information on how the variables were constructed.

The *market competition variable* deduces the degree of competition a firm faces from the relevance it gives to changes in competitors' prices to explain its own price decreases. A firm operating in a more competitive environment and facing higher uncertainty about its future position in the market can be expected to be more concerned with ensuring short-run returns, which leads to higher responsiveness to current shocks.

The external competitive pressure variable is designed to indicate whether prices are stickier when higher portions of a firm's sales are from overseas operations. There is always a tradeoff between the loss of keeping prices unchanged and the cost of adjusting supply. The latter may include fixed costs of entry into the foreign market, which the firm could not recuperate if it decided to scale down supply.

Recent micro-level survey data evidence (see, for instance, Dhyne et al., 2007, Fabiani et al., 2007, and Vermeulen et al., 2012, among others) shows that *labor-intensive sectors* are typically characterized by lower frequencies of price changes, suggesting that stickiness in wages and labor costs may be one of the driving factors behind the slow adjustment of prices.

According to Fabiani et al. (2007), *price reviewing rules* might differ in the presence of frequent shocks: Time-dependent pricing might lead to stickier prices than state-dependent pricing, provided that the time frame is quite large and that the cost of adjustment is low. In the presence of nominal price rigidity, monetary policy can affect economic activity in the short run because it is able to respond to shocks before wages and prices adjust.

The following part of the analysis discusses the logic behind the variables employed as covariates in the nominal wage rigidity model specification.

In an imperfect labor market, *trade unions* play an important role in wage determination. The adoption of a less centralized (i.e. firm-level) wage setting agreement is expected to invoke higher wage flexibility.

The empirical literature points out that *permanent contracts* have a stronger effect on wage rigidity in countries with stricter labor regulations. According to Garibaldi (2006), it is very difficult to measure the degree of enforcement of these regulations because some countries may have rigid standards that are only softly enforced, whereas other apparently flexible countries enforce standards very strictly.

The field literature also suggests that wages of *high-skilled workers* are likely to display higher downward rigidity than those of low-skilled workers. Some characteristics of the labor force might prove to be very important in corroborating this suggestion. For instance, wage compressions (Garibaldi, 2006) could lead to situations in which firms change their recruiting behavior. More specifically, companies could adjust the quantity of their workforce and replace unskilled with skilled workers. The main reason for this willingness to hire overly qualified workers might be the lack of reservations that overly qualified workers will quit as soon as possible, which in turn could be considered an indicator of poor outside options. According to Mojsoska-Blazevski and Kurtishi (2012), overqualification in the Republic of Macedonia is higher than that in most of the EU Member States.

The availability of alternative margins of labor cost adjustment other than adjustment of base wages is essential to evaluate the overall degree of labor cost flexibility. The *share of flexible components* was included to measure the extent to which firms with a higher share of the *flexible pay components* in total labor costs are also those with a lower degree of wage rigidity.

Following the literature, it can be expected that firms experiencing high *workforce turnover* adjust wages more often. A high turnover of skilled workers and a high percentage of novices may be harmful to a company's productivity.

3.2 Prior Implementation

As the harmonized questionnaire of the WDN was used for the Macedonian survey, thus basing the latter on the same underlying theoretical concept as the EU survey, we can exploit information from countries in the EU survey to improve our coefficient estimates. Using the study by Druant et al. (2009) as a reference study, we construct our prior as follows. For the coefficient associated with variable i, we center the prior mean β_i on the corresponding coefficient estimate obtained by Druant et al. (2009). The resulting posterior distribution is thus a weighted average of our data information and the information originating from a study conducted in another country. The weight attached to this specific information is controlled by the hyperparameter δ, which is estimated simultaneously with the other coefficients.

The hierarchical nature of our model implies that we let the data inform us about the appropriateness of the prior choice. Thus, the question of whether the study by Druant et al. (2009) is appropriate in our context is handled in an automatic fashion. Additionally, we estimated our models using uninforma-

Table 1

Prior Means

Variable	Mean
Price rigidity equation	
Competitive pressure	–0.300
Share of exports	–0.141
Labor cost share	0.504
State-dependent pricing	–0.241
Wage rigidity equation	
Competitive pressure	0.012
Share of exports	–0.023
Share of permanent workers	0.030
Workforce turnover	–0.170
Share of high-skilled workers	0.012
Collective agreement at firm level	–0.088
Share of bonuses on total wage bill	–0.160
Wage indexation policy	–0.393

Source: Druant et al. (2009).

Note: The data used for this paper consist of a subset of the dataset collected by the Wage Dynamics Network survey. This subset concentrates on 15 EU countries for which fully harmonized data are available, namely Austria, Belgium, the Czech Republic, Estonia, France, Greece, Hungary, Italy, Ireland, Lithuania, the Netherlands, Poland, Portugal, Slovenia and Spain. In addition, the covariates used in our ordered probit models are a subset of our benchmark case, with the exception of the state-dependent pricing variable. The reference for this variable is Martins (2013), who analyses the survey data of Portugal.

tive priors on the latent regression model. The results thus obtained were quite similar to those obtained from the baseline model described above.

4 Empirical Results

This section investigates the key determinants influencing the frequency of price and wage changes across Macedonian firms within a multivariate framework.

4.1 Investigating the Determinants of Price Changes

A core part of this overview section basically represents a model of the frequency of price changes that accounts for the interaction of a number of firm-level characteristics, such as the degree of market competition, price reviewing rules, as well as the relative importance of labor costs. The variable frequency of price changes is intended to provide a rough measure of the extent of nominal rigidities.

We estimate an ordered probit model in which the dependent variable is the four-category variable defined in section 2. The model also controls for firms' characteristics, such as the sector of activity (manufacturing, construction, trade or business services) or size (in terms of employees: 20 to 49, 50 to 199, 200 or more).

The results summarized in table 2 confirm the presence of some cross-sectional differences in price rigidity between firms. Comparing firms in manufacturing (the reference category) with their counterparts engaged in construction, trade and market services reveals that the former are less prone to leaving the price unchanged for more than one year. The estimates also show that prices are changed less frequently in large firms (firms with more than 20 employees). Conversely, our survey data confirms that higher price flexibility, observed as an increase in the frequency of price adjustment, is more typical of the small firms that perceive strong or severe market competition. In addition, price setting by small companies is found to be more diverse than price setting by larger companies, which most often use markup over cost as their pricing strategy.

Investigation of the specific market structure shows that firms operating in more competitive environments change their prices more frequently. A similar result is also found for the exposure to foreign markets. Thus, companies that increasingly operate abroad tend to adjust prices faster than their purely domestic counterparts. This corroborates the findings of Hall et al. (2000). The results also indicate that price reviewing rules do not seem to have a statistically significant bearing on the frequency of price changes. The results of the analysis of firms' cost structure confirm that a greater share of labor costs in total costs is associated with lower price flexibility, thus suggesting that stickiness in wages and labor costs

Table 2

Price Rigidity: Posterior Means and 95% Credible Sets

		Percentile	
Variable	Mean	5%	95%
Intercept*	2.106	1.824	2.394
Construction*	–0.994	–1.324	–0.656
Trade*	–1.462	–1.701	–1.224
Market services*	–0.385	–0.628	–0.141
20–49*	0.447	0.201	0.692
50–199*	0.449	0.221	0.68
>200*	0.828	0.444	1.208
Competitive pressure*	–0.251	–0.454	–0.048
Share of exports*	–0.034	–0.037	–0.031
Labor cost share*	0.461	0.283	0.634
State-dependent pricing	0.126	–0.051	0.296

Source: Authors' calculations.

Note: (*) denotes statistical significance at 5%.

might be one of the factors behind the slow adjustment of prices.

While the coefficient estimates described above provide a rough picture of the relative importance of several variables for the frequency of price changes, we are ultimately interested in the probability of price changes. We determine this probability by investigating the marginal effects, which establish a relationship between the covariates and the probability of each company to adjust prices.

The marginal effects summarized in table 3 show that firms operating in the most competitive environments are 7.8% less likely to leave prices unchanged for more than one year and 5.8% more likely to change prices within a one-month period than firms operating in the least competitive environment. The results also indicate that firms with high exposure to foreign markets are 51.2% less likely to leave prices unchanged for more than one year and 90.4% more likely to change prices within a one-month period than firms with the smallest portion of foreign sales.

Controlling for the cost structure indicates that firms with the greatest share of labor costs in total costs are 13.5% more likely to leave prices unchanged for more than one year and 11.3% less likely to change prices within a one-month period than firms with the least labor-intensive processes. Also, firms with more than 200 employees are 29.4% more likely to leave prices unchanged for more than one year and 13.6% less likely to change prices within a one-month period. Moreover, trade firms are 33.9% less likely to leave prices unchanged for more than one year and 43.1% more likely to change prices within one month than manufacturing firms.

Table 3

Marginal Effects – Price Rigidity

			Percentile	
Variable	Probability	Mean	2.50%	97.50%
Construction*	Y=1	0.326	0.173	0.480
	Y=2	0.030	–0.033	0.075
	Y=3	–0.158	–0.232	–0.083
	Y=4	–0.198	–0.255	–0.136
Trade*	Y=1	0.431	0.334	0.528
	Y=2	0.092	0.041	0.144
	Y=3	–0.184	–0.241	–0.133
	Y=4	–0.339	–0.407	–0.274
Market services*	Y=1	0.104	0.024	0.195
	Y=2	0.047	0.014	0.081
	Y=3	–0.048	–0.095	–0.010
	Y=4	–0.104	–0.175	–0.029
20–49*	Y=1	–0.092	–0.145	–0.035
	Y=2	–0.079	–0.140	–0.024
	Y=3	0.024	0.005	0.045
	Y=4	0.147	0.047	0.255
50–199*	Y=1	–0.097	–0.151	–0.043
	Y=2	–0.077	–0.133	–0.028
	Y=3	0.029	0.010	0.051
	Y=4	0.144	0.055	0.243
>200*	Y=1	–0.136	–0.190	–0.076
	Y=2	–0.155	–0.243	–0.063
	Y=3	–0.003	–0.069	0.038
	Y=4	0.294	0.122	0.466
Competitive pressure*	Y=1	0.058	0.002	0.111
	Y=2	0.041	0.001	0.087
	Y=3	–0.021	–0.042	–0.001
	Y=4	–0.078	–0.158	–0.002
Share of exports*	Y=1	0.904	0.861	0.935
	Y=2	–0.104	–0.144	–0.062
	Y=3	–0.288	–0.345	–0.237
	Y=4	–0.512	–0.580	–0.442
Labor cost share*	Y=1	–0.113	–0.168	–0.061
	Y=2	–0.068	–0.105	–0.035
	Y=3	0.046	0.022	0.075
	Y=4	0.135	0.074	0.199
State-dependent pricing	Y=1	–0.031	–0.082	0.021
	Y=2	–0.019	–0.051	0.013
	Y=3	0.013	–0.008	0.037
	Y=4	0.037	–0.025	0.097

Source: Authors' calculations.

4.2 Investigating the Determinants of Wage Changes

In contrast with the evidence found for price rigidity, the results on wage rigidity summarized in table 4 show that the degree of wage flexibility does not differ

substantially across sectors, no matter what sector is used as a reference category. This does not hold for the size variable: The degree of wage rigidity seems to decrease in line with firm size. In other words, wage rigidity is more prevalent in small firms than in large firms. We offer the following explanation for the observation that firm size is associated with more price rigidity but less wage rigidity: According to the survey, small firms facing strong or severe competition that are not involved in collective wage agreements tend to absorb input cost shocks mainly by reducing other costs, but also to a large extent by directly adjusting prices. This explains the higher flexibility of small firms' prices. Conversely, big firms tend to absorb input cost shocks predominantly by reducing other costs and by reducing their profit margins, which can be one reason for the higher rigidity of big firms' prices. The fact that big firms have more flexible wages is a signal of higher allocative efficiency, meaning that big firms generally find it easier to absorb shocks or to adjust to structural changes. Furthermore, small firms more often apply a smaller share of flexible wage components, reducing their wage flexibility. Additionally, small firms with low turnover rates (low quit rates) are characterized by stronger wage rigidity. Assuming that firms with low quit rates are those with high turnover costs, such firms have an incentive to avoid wage cuts in order to reduce (costly) job quits. Firm-level collective bargaining does not seem to have a statistically significant impact on wage flexibility.

The results on the flexibility of firms' cost structure and the characteristics of their labor force show that firms in which flexible pay components (i.e. bonuses) account for a greater share of total labor costs exhibit a higher degree of base-wage flexibility. On the other hand, the results demonstrate that the impact of the share of permanent employees on wage flexibility is not statistically significant. The literature also suggests that wages of high-skilled workers are likely to display higher rigidity than those of low-skilled workers. However, table 4 clearly shows that firms with a higher share of high-skilled workers do not display a statistically different attitude toward wage flexibility than firms with low-skilled workers. To some extent, this might reflect the relatively poorer outside options of high-skilled workers as well as their overqualification. On the other hand, the results show that the use of the alternative price margins of labor cost adjustment (like the adoption of bonus schemes) increases wage flexibility.

In addition, the marginal effects summarized in table 5 show that firms operating in the most competitive environments are 11.7% more likely to leave wages unchanged for more than one year and 10.3% less likely to change wages more than once a year than firms which operate under the least competitive pressure. Also, firms with the

Table 4

Wage Rigidity: Posterior Means and 95% Credible Sets

		Percentile	
Variable	Mean	5%	95%
Intercept*	1.275	0.926	1.634
Construction	–0.190	–0.531	0.156
Trade	0.068	–0.198	0.334
Market services	0.130	–0.130	0.389
20–49*	–0.462	–0.745	–0.173
50–199*	–0.627	–0.880	–0.376
>200*	–0.537	–0.872	–0.203
Competitive pressure*	0.366	0.163	0.571
Share of exports	0.000	–0.003	0.003
Share of permanent workers	–0.031	–0.232	0.164
Workforce turnover*	–0.006	–0.007	–0.005
Share of high-skilled workers	–0.109	–0.292	0.073
Collective agreement at firm level	0.089	–0.096	0.273
Share of bonuses on total wage bill*	–0.011	–0.015	–0.007
Wage indexation policy*	–0.372	–0.575	–0.169

Source: Authors' calculations.

Note: (*) denotes statistical significance at 5%.

highest workforce turnover are 34% less likely to leave wages unchanged for more than one year and 85.8% more likely to change wages more frequently than yearly than firms with the smallest staff turnover. In addition, firms that adopt indexation strategies are 11.8% less likely to leave wages unchanged for more than one year and 10.6% more likely to change wages more frequently than yearly than firms that do not follow a policy of indexing wages to prices.

5 Conclusions

This paper exploits the information collected from an ad hoc survey conducted on a sample of Macedonian firms to study the extent of nominal price and wage rigidities. The data show that in the Republic of Macedonia, changes in wages occur less frequently than changes in prices. Wages tend to remain unchanged for an average of 16 months. In addition, job tenure is the most important factor behind wage adjustments. Unlike wages, prices tend to remain unchanged for only 7 months. Prices of firms in construction, trade and market services are consistently found to be less sticky than those of firms in manufacturing. The estimates also show that prices tend to be stickier in large firms (firms with 20 or more employees). In addition, unlike price rigidity, the degree of wage flexibility does not differ substantially across sectors. This does not hold for the size variable: Large firms (firms with 20 or more employees) tend to have more flexible wages.

The multivariate analysis of the determinants of price and wage rigidity at the firm level confirms that more frequent price adjustments are associated with more intense competitive pressure and a higher exposure to foreign markets as well as with a lower share of labor costs in total costs.

Higher wage flexibility, on the other hand, is contingent on the presence of higher workforce turnover, the availability of margins of labor cost adjustment

Table 5

Marginal Effects – Wage Rigidity

			Percentile	
Variable	Probability	Mean	2.50%	97.50%
Construction	Y=1	0.057	–0.053	0.190
	Y=2	0.001	–0.034	0.019
	Y=3	–0.058	–0.173	0.079
Trade	Y=1	–0.016	–0.094	0.071
	Y=2	–0.008	–0.045	0.016
	Y=3	0.024	–0.084	0.137
Market services	Y=1	–0.031	–0.105	0.048
	Y=2	–0.014	–0.056	0.011
	Y=3	0.046	–0.059	0.156
20–49*	Y=1	0.139	0.032	0.254
	Y=2	–0.001	–0.044	0.024
	Y=3	–0.138	–0.223	–0.038
50–199*	Y=1	0.187	0.092	0.288
	Y=2	0.000	–0.041	0.031
	Y=3	–0.188	–0.266	–0.105
>200*	Y=1	0.169	0.038	0.313
	Y=2	–0.017	–0.085	0.017
	Y=3	–0.152	–0.241	–0.046
Competitive pressure*	Y=1	–0.103	–0.180	–0.032
	Y=2	–0.014	–0.035	0.005
	Y=3	0.117	0.041	0.190
Share of exports	Y=1	0.005	–0.083	0.106
	Y=2	–0.003	–0.043	0.020
	Y=3	–0.002	–0.118	0.123
Share of permanent workers	Y=1	0.008	–0.054	0.067
	Y=2	0.003	–0.015	0.027
	Y=3	–0.011	–0.093	0.069
Workforce turnover*	Y=1	0.858	0.822	0.889
	Y=2	–0.517	–0.569	–0.463
	Y=3	–0.340	–0.391	–0.291
Share of high-skilled workers	Y=1	0.028	–0.028	0.084
	Y=2	0.009	–0.008	0.032
	Y=3	–0.037	–0.112	0.036
Collective agreement at firm level	Y=1	–0.023	–0.079	0.034
	Y=2	–0.008	–0.031	0.010
	Y=3	0.030	–0.044	0.107
Share of bonuses on total wage bill*	Y=1	0.361	0.187	0.534
	Y=2	–0.103	–0.223	–0.008
	Y=3	–0.258	–0.332	–0.171
Wage indexation policy*	Y=1	0.106	0.034	0.180
	Y=2	0.012	–0.007	0.033
	Y=3	–0.118	–0.189	–0.042

Source: Authors' calculations.

Note: (*) denotes statistical significance at 5%.

other than changes in wages, as well as on the presence of formal or informal wage indexation clauses. The Bayesian approach employed in this paper allows us to combine the prior information obtained from existing studies with our data information, thus effectively updating our beliefs. This mechanism in fact sets the floor for a comparative dimension. Basically, this comparative dimension is built into the model's logic, so that we are able to draw reasonable conclusions about the price and wage rigidity similarities and differences between the Republic of Macedonia and the EU. This framework is rather general and can be employed as a platform for bilateral comparisons between any individual countries or between a country and the average EU outlook.

The survey data are also largely consistent with the macro evidence, notably in the light of macroprudential adjustments to address employment and wage cuts in the aftermath of the global financial and economic crisis. Finally, the inflation outlook in the postcrisis period reflects firms' strategies of adjusting prices after facing an adverse demand shock with the intention of counteracting the negative effect of the demand shock as much as possible.

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Annex: Covariates – Technical Summary

Determinants of Price Stickiness

Competitive pressure: dummy that takes a value of one if a firm considers a price decrease likely or very likely when its main competitors decide to cut their prices

Share of exports: export sales as a percentage of total turnover

State-dependent pricing: dummy that takes a value of one for firms that reply that they change their prices without any predefined frequency (prices are reviewed in response to movements in economic conditions) and zero otherwise

Labor cost share: dummy that takes a value of one for firms whose labor cost share overshoots the sample's median share (35%) and zero otherwise

Determinants of Wage Stickiness

Collective agreement at firm level: dummy that takes a value of one if the firm adopts a firm-level collective agreement

Share of permanent workers: dummy that takes a value of one for firms whose share of permanent workers is equal to or greater than the sample median (85%)

Workforce turnover: workers who leave the firm as a percentage of the total workforce (total number of employees in the firm)

Share of high-skilled workers: dummy that takes a value of one for firms in which the share of high-skilled employees is equal to or greater than the sample median (74%)

Share of bonuses on total wage bill: bonus payments as a percentage of total labor costs

Wage indexation policy: dummy that takes a value of one for firms that adopt any form of wage-to-price indexation and zero otherwise

Table A1

Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	Standard deviation
Competitive pressure	514	0	1	0.720	0.450
Share of exports	514	0	100	24.000	37.560
Labor cost share	514	0	1	0.490	0.500
State-dependent pricing	514	0	1	0.540	0.500
Share of permanent workers	514	0	1	0.660	0.480
Workforce turnover	514	0	100	24.200	87.090
Share of high-skilled workers	514	0	1	0.550	0.500
Collective agreement at firm level	514	0	1	0.420	0.490
Share of bonuses on total wage bill	514	0	100	10.720	22.470
Wage indexation policy	514	0	1	0.240	0.430
Frequency of price adjustments	329	1	4	2.620	1.050
Frequency of wage adjustments	417	1	3	2.060	0.700

Source: Authors' calculations.

Note: More detailed information on the dataset and the survey used is available on request.